BIOLOGY

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(CLASSES XI – XII)

In the present attempt of the NCERT to revise the Biology syllabus of the Classes XI and XII, several documents like 'Learning without Burden', the National Curriculum Framework– 2005, the report of the 'National Focus Group on Teaching of Science' as well as reports of several external and internal reviews carried out, helped to decide the main focus of the revision. Hence, the revised syllabus aims primarily at reducing the information load while ensuring at the same time that ample opportunities and scope for learning and appreciating basic concepts of Biology continues to be available within the framework.

The Biology Syllabus reinforces the ideas introduced in the lower classes while the children learn new concepts besides getting an exposure to contemporary areas of Biology. This syllabus aims also at emphasising the underlying principles that are common to both animals and plants, as well as highlighting the interrelationships of Biology with other areas of knowledge. The format of the syllabus allows a simple, clear, sequential flow of concepts without any jarring jumps. The empirical experience gained and practical exercises carried out during the course would prepare the student to handle Biology easily at higher levels in case she/he opts to continue further studies in this area.

The revised syllabus stresses the connection of the study of Biology to real life problems – use of biological discoveries/innovations in everyday life – in environment, industry, medicine, health and agriculture.

Since it was important that the quality of Biology education at the higher secondary level was not compromised in any way, the reduction in load from the syllabus required a very careful selection of topics to be taught. The Committee chose to leave topics out if: the question about why the child needs to study the topic at the particular stage could not be answered; if the topic had no direct relevance to the child i.e. was not contextual; if the content was repetitive across stages with no change in expected understanding, and if any topic was in isolation with no evident horizontal or vertical linkages. The need for a network of ideas and cross-linking between the areas being identified was deemed very important. While deciding on the units/topics and the depth of each topic for the higher secondary level, a holistic view of the syllabus across all stages from the primary to the higher secondary and beyond was taken. Reducing the use of too many technical terms and avoiding very large numbers of examples will also help to make the content a little lighter. The importance of careful selection of illustrations and their use to make the concepts more explicit was stressed; in Biology the quality of illustrations can make or mar any attempt at good textbooks/teaching.

The principal objective at this stage would be to explore the variations amongst the living and developing respect for the diversities, and to appreciate that the most complex biological phenomena are also built on essentially simple processes. Learning Biology should uncover these elementary aspects and illustrate their linkage to more complex phenomena. It was also felt that the contributions of scientists (women scientists in particular) that led to critical and important discoveries in Biology should be highlighted, not merely through a chronological listing, but through brief biographical

discussions, in an effort to bring out the processes that led to the discovery of principles and ideas in Biology. These would stimulate critical and creative thinking. Besides, the proposed course at the higher secondary stage provides substantial orientation to the students to professional/career opportunities available in medicine, agriculture, research, teaching and industry.

The syllabus also takes up issues pertaining to environment, health and other ethical issues that arise with any interference of human beings in the natural processes, which have great relevance from the societal point of view. A discussion on these in the prescribed syllabus would help tackle prevalent misconceptions and empower the student to play a rational, responsible and informed role in society.

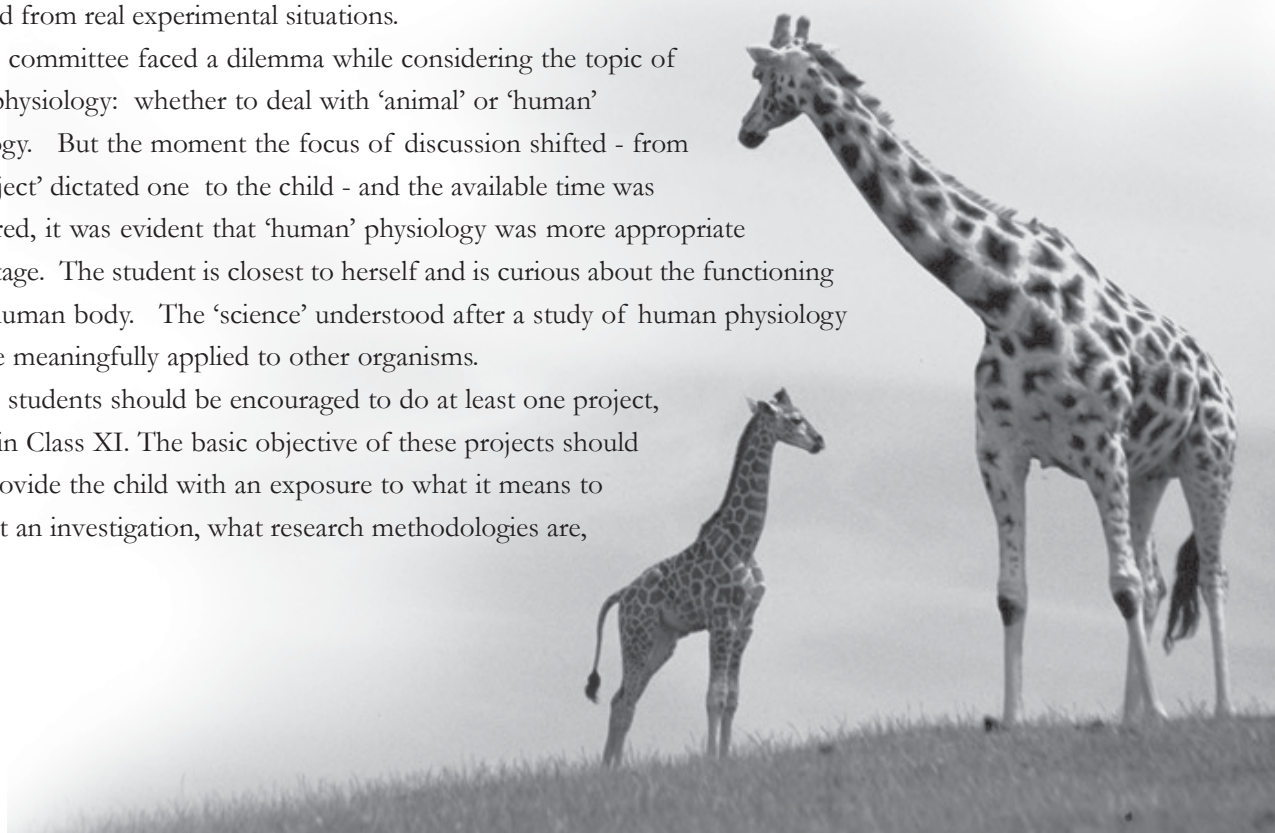
In each unit after giving the various sub topics, "*key points for developing subject matter*" are given in the form of bulleted sentences. These, we believe, will serve as a guide for the flow of concepts while developing the unit in the class as well as in the textbook. The teaching time in terms of number of periods available is indicated for each unit (total 180 periods). These key points, along with the number of classes allocated for each unit, provide a reasonable guide to the depth at which each unit is to be taught. These should be especially considered at the book writing stage to avoid overburdening and expansion beyond available teaching time.

Each unit in the theory course carries suggestions for practicals. It is expected that the practical aspects will be integrated into the chapters in the textbook such that the rationale for doing them is evident and the understanding gained from them would help in furthering the understanding of the concepts. These experiments should be in the form of investigative reporting and be given along with the text.

The young student would get an exposure to the various branches of Biology in a more contextual and friendly manner as they studied various units in the syllabus; each unit could also provide a glimpse of the career opportunities in the particular area. After studying any unit, the child gets an opportunity to think more deeply and to form informed opinions. The description of the diverse/various tools and techniques used in the study of Biology have not been collated to form a distinct unit in the syllabus. It is envisaged that the teachers who teach this syllabus and the textbooks prepared based on it, will discuss techniques in a contextual manner rather than distanced from real experimental situations.

The committee faced a dilemma while considering the topic of animal physiology: whether to deal with 'animal' or 'human' physiology. But the moment the focus of discussion shifted - from the 'subject' dictated one to the child - and the available time was considered, it was evident that 'human' physiology was more appropriate at this stage. The student is closest to herself and is curious about the functioning of the human body. The 'science' understood after a study of human physiology could be meaningfully applied to other organisms.

The students should be encouraged to do at least one project, may be in Class XI. The basic objective of these projects should be to provide the child with an exposure to what it means to carry out an investigation, what research methodologies are,



how data is analysed and presented and, how to interpret data and draw conclusions. The project should provide space for the child to choose a theme in the area of her interest, think independently, allow autonomous working and also provide freedom to present the project in any format of her/his choice, thus improving her/his communication skills.

The syllabus committee hopes that the spirit of the exercise is carried forward to the textbooks and the classrooms, across the country, ultimately meeting our objective of reducing the burden on the child while making learning Biology exciting. Teaching should emphasise on ways of acquiring knowledge rather than on conveying knowledge.

BIOLOGY CLASS XI

I. *Diversity in Living World*

Diversity of living organisms.

Classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom).

Systematics and binomial system of nomenclature.

Salient features of animal (non chordates up to phylum level, and chordates up to class level) and plant (major groups; Angiosperms up to subclass) classification.

Botanical gardens, herbaria, zoological parks and museums. **(Periods 25)**

Key points for developing subject matter

- The meaning of being 'alive'.
- Living organisms show a very large diversity in form and structure ranging from unicellular to very large multicellularwell-differentiated bodies.
- For ease of study, they have been organized into categories and this is called classification.
- Principally, all living organisms can be placed in one or the other of five kingdoms.
- Each kingdom is further subdivided; there are several levels of organisation, the lowest in the hierarchy being the species.
- The Binomial system, literally 'two names', of classification is followed, where each organism has a Latin generic name with a specific epithet.
- Zoological parks, Botanical gardens, Herbaria and Natural museums serve as Taxonomical aids.

Practicals

Study the large variation of living organisms in the neighbourhood, note their behaviour, characteristics, and categorize them into groups based on some common features. Study preserved specimens, at least one representative of each group, to understand correlations between the characteristics of organisms and their systematic position. Learn how to collect, press, dry and prepare plant specimens with labels (common and weedy species) for the herbarium/museum.

II. *Structural Organisation in Animals and Plants*

Tissues in animals and plants.

Morphology, anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence, flower, fruit and seed.

Morphology, anatomy and functions of different systems of an annelid (earthworm), an insect (cockroach) and an amphibian (frog). **(Periods 30)**

Key points for developing subject matter

- Light and electron microscopes are used as tools for the study of tissues, cells and cell organelles.
- Higher organisation of animals and plants is achieved through assembly of thousands/millions of cells into specialised tissues that in turn form organs and organ systems.
- The organisation of the living body shows division of labour.
- Organisms show increasing complexity in structure and function as we move from the lower to the higher levels.
- Plants and animals exhibit a wide range of organisation from a simple level to the complex.
- Floral characteristics form the basis of classification and identification of Angiosperms. This can be illustrated through semi-technical descriptions of families using suitable examples of wild and cultivated plants.
- The structure of the animal body shows a wide range in morphology and anatomy.

Practicals

Study different types of tissues in plants and animals (temporary preparations and permanent slides). Prepare and study transverse section of roots and stems to identify different tissues. Study of locally available plants and animals for their external morphology. Description of three common flowering plants in semi-technical terms (Solanaceae, Fabaceae and Liliaceae) and try to group them based on flower characteristics. Study the anatomy of roots, stems (through hand sections) and leaves (through permanent slides). Study of one vertebrate and one invertebrate for their morphology and internal organisation (through charts and models).

III. *Cell: Structure and Function*

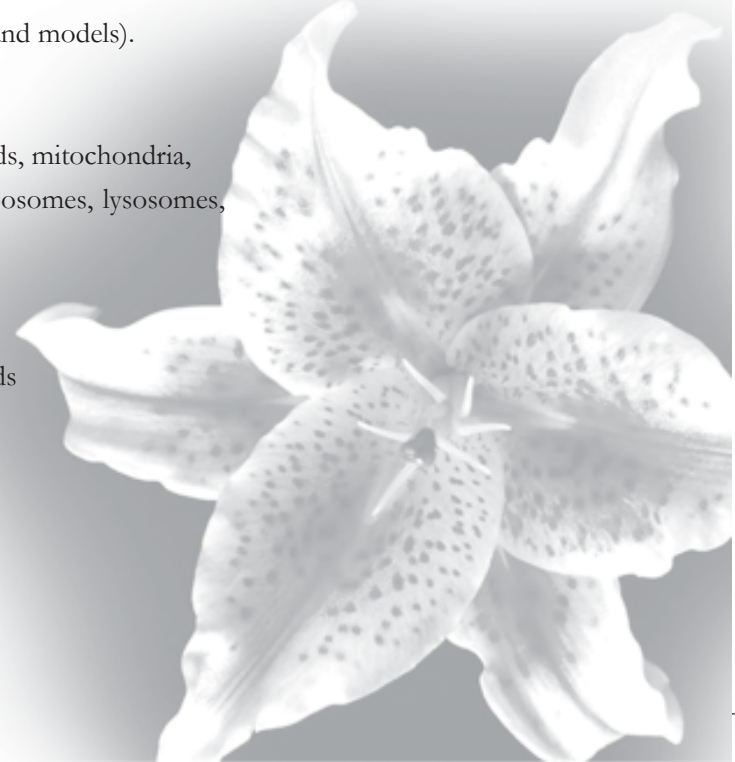
Cell: Cell wall, cell membrane and cell organelles (plastids, mitochondria, endoplasmic reticulum, Golgi bodies/ dictyosomes, ribosomes, lysosomes, vacuoles, centrioles) and nuclear organisation.

Mitosis, meiosis, cell cycle.

Basic chemical constituents of living bodies.

Structure and functions of carbohydrates, proteins, lipids and nucleic acids.

Enzymes: Types, properties and function. **(Periods 40)**



Key points for developing subject matter

- The cell organelles are designed to perform tasks such as synthesis, breakdown, respiration and transport.
- Essential processes of cell division – mitosis and meiosis are similar in animals and plants.
- Living bodies contain different categories of micro and macro-molecules.
- Macromolecules are of four broad categories.
- Proteins, the major macro group besides providing structural support, mediate many physiological functions like catalysis, defence, transport, and sensing.
- Enzymes are an important class of proteins responsible for all metabolic activities of the cell.
- Carbohydrates are major energy reserves, and also serve the function of providing structural support to majority of living organisms.
- Lipids serve as major components of membranes, as energy reserves and some hormones.
- The DNA has a double helical structure.
- Nucleic acids are the genetic material, and are responsible for determining the protein synthesis.

Practicals

Observe suitable animal and plant cells (sections and smears) to highlight similarities and differences. Study of mitosis in onion root tip and animal cells (permanent slides). Test for carbohydrates (glucose and starch), proteins and fats, and their detection in suitable plant and animal materials. Study the activity of the enzyme amylase/ trypsin/ papain (using milk powder as substrate).

IV. *Plant Physiology*

Movement of water, food, nutrients and gases.
Plants and water.
Mineral nutrition.
Respiration.
Photosynthesis.
Plant growth and development. **(Periods 40)**

Key points for developing subject matter

- Cell to cell movement of water, food, gas and nutrients is dependent principally on concentration gradients and diffusion.
- Substances are moved against a concentration gradient through active transport.
- The plants lose water through their stomata.
- Transport of water over larger distances in plants depends on transpiration pull.
- Root pressure is responsible for movement of water up short distances and for guttation.
- Plants require a variety of mineral nutrients for their growth and development.
- Some plants are able to fix atmospheric nitrogen.
- Green plants use the C3 pathway to fix carbon dioxide and synthesize simple sugars in the presence of sunlight.

- Some plants have the C4 pathway.
- Sugars are oxidised by all living organisms to release energy.
- Some organisms derive energy from food anaerobically.
- This energy is trapped as ATP and utilised for all metabolic activities.
- Growth regulators regulate growth and development in plants.

Practicals

Demonstrate requirement of chlorophyll and light for photosynthesis. Separate plant pigments using paper chromatography. Study rate of respiration in different plant materials. Demonstrate anaerobic respiration. Study transpiration in plants using Cobalt Chloride method. Study imbibition of water by seeds or raisins. Study plasmolysis and osmosis. Study the effect of apical bud removal on plants.

V. *Human Physiology*

Digestion and absorption.
Breathing and respiration.
Body fluids and circulation.
Excretory products and elimination.
Locomotion and movement.
Control and coordination. **(Periods 45)**

Key points for developing subject matter

- Food is broken down enzymatically in stages and nutrients absorbed as they pass through the alimentary canal.
- The process of exchange of gases takes place at organ, tissue, cell and organelle levels leading to oxidation of sugars in the cells.
- Gases, nutrients as well as waste products are transported in the body through the vascular system.
- The various components of the blood are involved in diverse functions.
- Metabolic wastes produced in the body are eliminated by excretory system.
- The kidneys play an important role in osmoregulation.
- Movement and locomotion involves interaction of the skeletal and muscular system; the skeleton also protects many parts of the body.
- Control and coordination require functional integration of neural and endocrine systems in the body.
- Sense organs are specialised to receive different stimuli and transmit them to the brain.

Practicals

Study diversity of food habits in different parts of the country and discuss the sources of carbohydrates, proteins, fats and other nutrients. Test different food items for macro-nutrients. Effect of temperature and pH on activity of salivary amylase. Study of permanent slides of human blood cells. Testing urine for urea and sugar. Study of the human skeleton, types of joints.

List of Practicals Class XI

1. Study parts of a compound microscope.
2. Study of the specimens and identification with reasons – Bacteria, *Oscillatoria, Spirogyra, Rhizopus*, mushroom. Yeast, liverwort, moss, fern, *Pinus*, one monocotyledon and one dicotyledon and one lichen.

3. Study of specimens and identification with reasons – *Amoeba*, *Hydra*, Liverfluke, *Ascaris*, leech, earthworm, prawn, silk worm, honeybee, snail, star fish, shark, *rohu,* frog, lizard, pigeon and rabbit.
4. Study of tissues, and diversity in shapes and sizes of plant and animal cells (e.g. palisade cells, guard cells, parenchyma, collenchyma, sclerenchyma, xylem, phloem, squamous epithelium, muscle fibres and mammalian blood smear) through temporary/permanent slides.
5. Study of mitosis in onion root tip cells and animal cells (grasshopper)(permanent slides).
6. Study of different modifications in root, stem and leaves.
7. Study and identify different types of inflorescences.
8. Study and describe three common flowering plants (Solanaceae, Fabaceae and Liliaceae).
9. Preparation and study of t.s dicot and monocot roots and stems (normal).
10. Study external morphology of earthworm, cockroach and frog through models.
11. Study of osmosis by potato osmometer.
12. Study of plasmolysis in epidermal peels (e.g. *Rhoeo* leaves).
13. Study of imbibition in seeds/raisins.
14. Study of distribution of stomata in the upper and lower surface of leaves.
15. Comparative study of the rates of transpiration in the upper and lower surface of leaves.
16. Test for the presence of sugar, starch, proteins and fats. Detect them in suitable plant and animal materials.
17. Separate plant pigments through paper chromatography.
18. Study rate of respiration in flower buds/leaf tissue and germinating seeds.
19. Observation and comments on the experimental set up on:
    (a) Anaerobic respiration.
    (b) Phototropism.
    (c) Apical bud removal.
    (d) Suction due to transpiration.
20. Study effect of different temperature salivary gland amylase on starch.
21. To test the presence of urea in urine.
22. To detect the presence of sugar in urine/blood sample.
23. To detect the presence of albumin in urine.
24. To detect the presence of bile salts in urine.
25. To study human skeleton and different types of joints.